CLAIMS

WE CLAIM:

1. A microminiature sensor module for invasive medical applications, comprising:

a substrate;

a microminiature sensor disposed on the substrate; and

a signal conditioning circuit disposed on the substrate and in electrical communication with the sensor;

wherein the signal conditioning circuit conditions an output signal of the sensor for transmission to a signal detection system.

2. The microminiature sensor module in accordance with claim 1, wherein the substrate is flexible.

3. The microminiature sensor module in accordance with claim 1, wherein the substrate is an integral part of the sensor.

4. The microminiature sensor module in accordance with claim 1, wherein the substrate defines a body region and two opposing arms having electrical contacts.

5. The microminiature sensor module in accordance with claim 3, wherein each electrical contact is disposed at an end of an arm away from the body region of the substrate.

6. The microminiature sensor module in accordance with claim 1, wherein the substrate is attached to a top surface of the sensor and a side surface of the signal conditioning circuit.

7. The microminiature sensor module in accordance with claim 1, wherein the sensor is adapted to measure pressure, temperature, or flow.

8. A sensing catheter system, comprising:

a catheter body having a circumferential wall and defining first and second lumens, the circumferential wall defining at least one opening to the second lumen;

first and second electrical leads disposed in the second lumen;

a microminiature sensor module disposed in the opening in the circumferential wall and adjacent the first and second electrical leads, the sensor module comprising a substrate, a microminiature sensor and a signal conditioning circuit disposed on the substrate, and first and second electrical contacts in electrical communication with the sensor and circuit;

first and second electrical connections between the first and second electrical leads and the first and second electrical contacts; and

sealant disposed over the sensor module and filling the opening in the circumferential wall.

9. The sensing catheter system of claim 8, wherein the sensor module is disposed between the first and second electrical leads.

10. The sensing catheter system of claim 8, further comprising a second sealant disposed over the sealant.

11. The sensing catheter system of claim 9, further comprising a retaining member disposed in the second lumen and engaged with the first and second electrical leads to form the first and second electrical connections as electrical compression bonds.

12. The sensing catheter system of claim 11, wherein the retaining member comprises a u-shaped clip.

13. The sensing catheter system of claim 8, wherein the substrate defines a body region and two opposing arms; and

wherein each electrical contact is disposed at an end of an arm away from the body region of the substrate.

14. The sensing catheter system of claim 8, wherein the second lumen comprises a main channel portion and first and second sub-channel portions.

15. The sensing catheter system of claim 14, wherein the first and second electrical leads are individually disposed in the first and second sub-channel portions and the sensor module is disposed in the main channel portion.

16. The sensing catheter system of claim 15, wherein the first and second electrical connections comprise ball bonds disposed between the sensor module and the first and second electrical leads.

17. The sensing catheter system of claim 15, wherein the first and second electrical connections comprise wire bonds.

18. The sensing catheter system of claim 15, wherein the first and second electrical connections comprise solder joints.

19. The sensing catheter system of claim 15, wherein the first and second electrical connections comprise weld joints.

20. The sensing catheter system of claim 15, wherein the first and second electrical connections comprise conductive adhesive joints.

21. The sensing catheter system of claim 17, wherein the first and second electrical leads each have at least one flat surface and the wirebond is attached to the at least one flat surface.

22. The sensing catheter system of claim 8, wherein the at least one opening comprises a plurality of spaced-apart openings in the circumferential wall; and

wherein a microminiature sensor module is disposed in each of the plurality of openings.

23. The sensing catheter system of claim 8, wherein the first and second electrical leads comprise ribbons.

24. The sensing catheter system of claim 8, wherein the first and second electrical leads comprise wires.

25. The sensing catheter system of claim 24, wherein the wires are shielded wires.

26. A sensing catheter system, comprising:

a catheter body having a circumferential wall and defining a first lumen and a second lumen having first and second shoulder regions, the circumferential wall defining at least one opening to the second lumen;

first and second electrical leads disposed in the second lumen;

a microminiature sensor module disposed in the opening in the circumferential wall and adjacent the first and second electrical leads, the sensor module comprising a substrate, a microminiature sensor and a signal conditioning

circuit disposed on the substrate, and first and second electrical contacts in electrical communication with the sensor and circuit;

a u-shaped retaining member disposed in the second lumen and engaged with the first and second electrical leads to place the first and second electrical leads in electrical communication with the first and second electrical contacts; and

sealant disposed over the sensor module, extending into the first and second shoulder regions, and filling the opening in the circumferential wall.

27. A method of fabricating a sensing catheter assembly, comprising:

forming a catheter body having a circumferential wall and defining first and second lumens,

placing first and second electrical leads in the second lumen;

forming an opening in the circumferential wall to expose the first and second electrical leads;

providing a microminiature sensor module comprising a substrate, a microminiature sensor disposed on the substrate, a signal conditioning circuit disposed on the substrate and in electrical communication with the sensor, and first and second electrical contacts in electrical communication with the sensor and circuit;

disposing the sensor module in the opening and adjacent the first and second electrical leads;

placing the first and second electrical contacts in electrical communication with the first and second electrical leads; and

sealing the opening.

28. The method of claim 27, wherein the placing the first and second electrical leads in the second lumen comprises co-extruding the first and second electrical leads and the catheter body.

29. The method of claim 27, wherein the placing the first and second electrical leads in the second lumen comprises threading the first and second electrical leads through the second lumen.

30. The method of claim 27, wherein the placing the first and second electrical contacts in electrical communication with the first and second electrical leads comprises positioning a retaining member adjacent the sensor module and first and second electrical leads.

31. The method of claim 27, wherein the placing the first and second electrical contacts in electrical communication with the first and second electrical leads comprises forming a ball bond between the sensor module and each of the first and second electrical leads.

32. The method of claim 27, wherein the placing the first and second electrical contacts in electrical communication with the first and second electrical leads comprises forming a wirebond between the sensor module and each of the first and second electrical leads.

33. The method of claim 27, wherein the placing the first and second electrical contacts in electrical communication with the first and second electrical leads comprises forming a weld joint between the sensor module and each of the first and second electrical leads.

34. The method of claim 27, wherein the placing the first and second electrical contacts in electrical communication with the first and second electrical leads comprises forming a solder joint between the sensor module and each of the first and second electrical leads.

35. The method of claim 27, wherein the placing the first and second electrical contacts in electrical communication with the first and second electrical leads comprises forming a conductive adhesive joint between the sensor module and each of the first and second electrical leads.